

Report on Integrated Pest Management and Related Activities
Supported by the United States Department of Agriculture

*Submitted to the House Agriculture, Rural Development,
Food and Drug Administration, and Related Agencies Appropriations Subcommittee*

May 18, 1998

Contents

Introduction

Background

The IPM Initiative

Addressing FQPA Challenges

Budget Resources

Major Results and Accomplishments

References

Introduction

This report presents information on the United States Department of Agriculture's (USDA) activities to develop and help farmers and other pest managers implement integrated pest management (IPM) systems. The report was requested by the Agriculture, Rural Development, Food and Drug Administration, and Related Agencies Appropriations Subcommittee of the House Appropriations Committee in the Department's fiscal year (FY) 1998 appropriation bill. The Subcommittee asked for a

A report detailing current programs and resources carried out by the Department with respect to pest management activities and efforts to focus, manage, and coordinate these significant resources (the Department estimated that \$216,000,000 was devoted to IPM and related programs in FY 1997) to accomplish IPM systems approaches to targeted farm acreage.®

The report provides an overview of the Department's activities. It provides background information on the IPM Initiative announced in 1994; a description of the formal and informal means the Department has employed to manage the Initiative; and an overview of major accomplishments since 1994. Detailed information on programs and activities by agency, program, location, crop, and target pests is being compiled and will be sent separately. The report also provides a brief discussion of the implications of the Food Quality Protection Act of 1996 (FQPA) and the Department's plans to respond to the new challenges posed by this law.

Background

Successful IPM programs provide economically and environmentally sound pest management strategies that use a wide range of chemical and nonchemical techniques to anticipate, prevent, and control pests. IPM strategies are science-based and information-driven, relying on education programs to deliver new pest management techniques to agricultural producers, private consultants, pesticide applicators, and other persons making pest management decisions. The use of IPM strategies contributes to a financially competitive agricultural industry while ensuring a safe food supply and a healthy environment. When practiced widely by farmers, food processors, homeowners and gardeners, IPM has the potential to simultaneously:

- ! Reduce environmental and human exposure to pesticides;
- ! Increase the profitability of farming;
- ! Protect natural resources; and
- ! Ensure consumers a supply of high-quality and safe foods and other agricultural products at reasonable cost.

A comprehensive evaluation of farm-level data from 61 IPM programs in the United States concluded that the adoption of IPM methods generally results in lower pesticide use, production cost and risk, and higher net returns to producers (Norton and Mullen, 1994). It has been estimated that use of IPM strategies saves U.S. agricultural producers more than \$500 million per year due to reductions in pesticide use and better management (Rajotte et al., 1987).

Although the benefits of the use of IPM methods have been well established, the extent of adoption has been limited by several factors. A series of workshops sponsored by the U.S. Environmental Protection Agency (EPA) and USDA in 1992 and 1993 identified many factors constraining adoption of IPM systems, and recommended that the public and private sectors make a national commitment to overcoming these constraints (Sorensen, 1993, 1994). Among the major impediments to greater adoption of IPM methods are inadequate knowledge of currently available IPM tactics, a shortage of consultants and other pest management professionals to provide IPM services, the high level of management input required for implementation of some IPM systems, and the lack of alternative pest control tactics for some pests. Before reforms were enacted in 1996, Federal commodity programs were another impediment to IPM adoption in cases where planting requirements restricted producers' ability to rotate crops for pest control.

The IPM Initiative

On December 14, 1994, the Department of Agriculture announced an IPM Initiative to provide agricultural producers with the tools they need to deal with the environmental and economic problems of pest control, and to help them implement some IPM methods on 75 percent of U.S. crop acreage by the year 2000 (USDA, 1994c). The IPM Initiative is designed to develop the knowledge and technologies that will make it possible for the majority of U.S. farmers to implement biologically based pest management systems with the potential to substantially reduce their reliance on broadly toxic chemical pesticides. In the long run these systems would likely result in large savings to agriculture and benefits to the environment. The IPM Initiative was part of a comprehensive pesticide policy presented to Congress in joint testimony by EPA Administrator Browner, USDA Deputy Secretary Rominger, and FDA Commissioner Kessler on September 21, 1993 (U.S. Congress, 1993).

Consensus has emerged among government, industry, academia, and public interest groups that adoption of IPM systems should be measured along a continuum, ranging from low to high levels of IPM adoption. The Department's 1994 report, *Adoption of Integrated Pest Management in the United States* (USDA, 1994a), measured adoption along a continuum, and this approach was refined by the Consumers Union in its 1996 report *Pest Management at the Crossroads* (Benbrook, 1996). These analyses estimated that up to 70 percent of crop acreage is currently managed using IPM systems, but that some crops are managed with rudimentary methods at the low end of the IPM continuum. Our goal is to develop and help growers implement IPM strategies that permit them to move from the low end of the continuum to the high end of the continuum, moving incrementally toward biologically based IPM systems.

The Department's strategic plan for the IPM Initiative (USDA, 1994b) fulfills the Administration's IPM mandate by setting out specific objectives related to program coordination, research and implementation, evaluation, and communication. The plan states that the goal of the IPM Initiative is to ensure that USDA carries out a single coordinated department-wide plan of research, education and action programs, in cooperation with state and private entities, that ensures the wide scale adoption of IPM systems that meet the needs of agriculture and the American public.® The strategic plan was based on the principle that the success of USDA's IPM efforts will be judged on their ability to increase adoption of IPM

methods. The plan establishes a process for setting priorities at the appropriate local or regional level, linking research and education efforts to meet those priorities, and coordinating USDA efforts across agencies.

The goals of the IPM Initiative have been incorporated into the Department's strategic plan (USDA, 1997), which was developed in accordance with the Government Performance and Results Act of 1993 (Public Law 103-62). These goals have also been incorporated into the operating plans of agencies published and submitted to Congress as supporting documents for the FY 1999 budget. USDA Strategic Planning Goal No. 3, "To promote sensible management of our natural resources," includes implementation of the IPM Initiative through simple, cost-effective pest management practices that lead to adoption of effective techniques to reduce harmful effects on the environment.

The annual performance plan submitted by ARS for FYs 1997-2000 contains numerous performance goals: 1) Initiation of a new five year areawide IPM program for leafy spurge, a major pest in rangeland; 2) Development of artificial diets for predatory insects that provide biological control of the Colorado potato beetle, a major pest of potato crops throughout the United States; and 3) Development of integrated disease control strategies for strawberry and tomato to provide alternatives to preplant soil fumigation with methyl bromide, which is currently scheduled to be phased out in 2001.

Because Cooperative State Research, Education, and Extension Service (CSREES) relies on numerous cooperating institutions to conduct specific research and education projects, performance goals and indicators are stated in broad terms. The agency's goals for IPM for the next planning cycle are to: 1) Expand the base of knowledge and technologies available for managing pests; 2) Develop and demonstrate the viability of new IPM systems that reduce reliance on pesticides and maintain profitability; 3) Provide education to introduce IPM methods to farmers and help them implement IPM methods on 75 percent of cropland; and 4) Help farmers and other pest managers increase implementation of medium and high level IPM systems; and 5) Support the development of the crop consulting profession.

USDA, APHIS has a unique roll in assisting the research community in developing IPM programs. It has the ability to develop large scale implementation programs such as the multi-State releases of natural enemies of weeds such as leafy spurge, diffuse and spotted knapweeds, purple loosestrife as well as the silverleaf whitefly, Russian wheat aphid, and cereal leaf beetle. In addition, APHIS can assist in the mass production of natural enemies for large field trials in support of the development of IPM programs with other Federal agencies and State cooperators.

A USDA IPM Coordinating Committee was established in 1994 to provide interagency guidance on policies, programs, and budgets. The committee gives research leaders and scientific staffs from eight relevant agencies¹ an opportunity to develop policies and strengthen

¹Agricultural Marketing Service (AMS); Agricultural Research Service (ARS); Animal and Plant Health Inspection Service (APHIS); Cooperative State Research, Education, and Extension Service (CSREES); Economic Research Service (ERS); Forest Service (FS); National Agricultural Statistics Service (NASS); Natural Resources Conservation Service (NRCS).

coordination of programs that form the IPM Initiative. Members of the IPM committee use an extensive network of formal and informal relationships with the other groups and organizations to identify, prioritize, and coordinate programs so that they can meet the needs of customers and partners on a continual basis. Coordination is further strengthened at the regional level by ARS area offices and CSREES-supported regional research and extension committees. The programs that emerge are based upon legislative, customer, scientific, and other stakeholder inputs on needs, priorities, and expectations.

The IPM Initiative is based on a recognition that successful achievement of its goals is dependant upon the extent that producers and other end-users are involved setting priorities for research and education activities. The Department is committed to maximizing the impact of existing resources by improving coordination of IPM and related pest management programs across eight agencies. However, existing resources and programming are not adequate to allow the Department to adequately address the array of challenges, such as the FQPA of 1996, confronting agricultural producers and urban pest managers in the United States over the next decade. As required by Vice President Gore's April 8, 1998, memorandum concerning the administration and implementation of FQPA, the Department is currently reevaluating all of its pest management and pesticide data programs to support a reasonable transition for agriculture in meeting the new requirements of the law.

The IPM Initiative was designed to further invest in the research and education programs needed to increase adoption of high end IPM systems. This will benefit all Americans by increasing profitability, protecting water quality and farm worker safety, and enhancing the wholesome quality of our Nation's food supply. The accelerated development and implementation effort proposed by the Department will help growers implement pest management strategies that reduce reliance on the most highly toxic pesticides and enhance the sustainability of their operations.

Addressing FQPA Challenges

In FY 1997, the Department focused available resources on helping U.S. agriculture adjust to changes resulting from implementation of the FQPA of 1996 (FQPA). USDA and its land-grant university partners have an important role to play in providing affected pesticide users with the knowledge, technical assistance, and support they need to transition to new pest management strategies. This federal-state partnership has the capacity to provide pest managers with science- and education-based solutions to the challenges that will be faced over the next several years. These solutions must be based on a sound understanding of existing pest management practices and pesticide use patterns, and the impacts of regulatory decisions on pest management options. Alternative pest management approaches must be developed to replace pesticides removed from the marketplace as a result of regulatory action. And finally, extension education programs are needed to help farmers and others to implement new approaches to managing pests. Nearly all of the programs described in this report will have a role to play in addressing the challenges resulting from the implementation of FQPA. These programs, working in conjunction with EPA, growers, and registrants, are currently:

- ! Evaluating the impacts likely to result from the loss of pesticide active ingredients;
- ! Determining what active ingredients will remain and how efficacious they are;

- ! Determining what alternative tactics are in the developmental pipeline or in the registration process, and what is required to bring them into full utilization;
- ! Identifying knowledge and technology gaps in pest management systems;
- ! Determining what is needed to fill those gaps; and
- ! Conducting research and extension programs to fill identified gaps and assisting growers in implementing them.

The Department has taken steps to work with its land-grant partners, producer organizations, EPA, and other interested groups to make sure ongoing research and extension activities are addressing needs resulting from FQPA implementation. The outcome of this priority-setting process will be used to set basic and applied research and extension priorities in FY 1999, and will determine priorities for the FY 2000 budget request. Needs, priorities, and the status of research efforts will be routinely reviewed, evaluated, and adjusted as appropriate. CSREES and EPA sponsored an FQPA workshop February 18-19, 1998, to provide participants with background information, training, and resource materials on FQPA. The workshop was attended by approximately 140 individuals from USDA, land-grant universities, state departments of agriculture, the agriculture chemical industry, commodity groups, consumer and environmental groups, and the food industry. A train-the-trainer® approach was used combining formal presentations and break-out discussion sessions. The workshop provided an experiential learning environment to increase interaction and learning among industry, regulatory, and research and extension professionals.

The Office of Pest Management Policy (OPMP) was established on September 8, 1997, to improve USDA's ability to address FQPA by improving integration and coordination of pest management and pesticide data programs, and by strengthening communications with the existing network of grower organizations and crop specialists at land-grant institutions. The activities coordinated by OPMP will help increase USDA's responsiveness to the pest management needs of the agricultural community. Overall, OPMP has been designated as USDA's lead office on pest management policy, and will coordinate USDA's interface with EPA, FDA, growers and interested groups on pest management and pesticide-related issues. OPMP will be directly responsible for developing and implementing the Department's overall pest management strategy to adequately meet the needs of growers throughout the FQPA implementation process.

Through OPMP, the Department is focusing the efforts of the National Agricultural Pesticide Impact Assessment Program (NAPIAP) on identifying crops most vulnerable to potential pesticide cancellations under FQPA. Land-grant university scientists and grower organizations are currently developing crop profiles that identify major pests, their current management options, and alternative IPM strategies. NAPIAP, under the direction of OPMP, will work with staff from the IPM and Minor Use (IR-4) programs to ensure that crop profiles are complete.

OPMP will use these crop profiles to develop transition strategies for crops that may lose key pesticide active ingredients as a result of FQPA. In some cases, transition to new pest management options may be possible in a short period of time. However, in many cases, it is likely that transition will take several years and require additional research, applicator education and training, and a commitment from EPA to grant timely regulatory decisions on new or alternative pesticide products.

The Pest Management Alternatives Program (PMAP) will continue supporting research to develop and implement new technologies when regulatory action results in the unavailability of certain pesticide active ingredients. Funding priorities will be established by CSREES in consultation with OPMP, EPA, grower groups, and public interest groups. The process will be directly linked to regulatory decisions made by EPA as it implements FQPA. The goal of PMAP is to quickly develop alternatives for critical pest management needs to ensure that American agriculture has safe, efficacious, and economically viable pest management options.

NASS' pesticide use surveys will continue to gather pesticide use and usage data and expand their efforts to measure IPM adoption, and, as necessary, continue to refine their surveys to ensure that appropriate data is readily available to improve the quality of EPA's risk assessments. The Agricultural Marketing Service will continue gathering actual pesticide residue information with a focus on foods comprising the majority of the diets of infants and children. These data will improve the accuracy and quality of EPA's dietary risk assessments. The FY 1999 budget plans call for the development of a quick response capability in this program to ensure all pesticide residue data gaps, particularly drinking water, are filled and that EPA is not forced to use assumptions that may overestimate pesticide residue exposure. ARS is currently conducting a supplemental survey of children's food consumption patterns. Based on EPA's request, the supplemental survey will include nearly 5,000 additional children and add increased statistical confidence to EPA's dietary risk assessments. ARS is also undertaking an inventory and assessment of its research relevant to at risk pesticides. The Food Safety Inspection Service is working with EPA to expand their routine pesticide tolerance enforcement program to measure actual pesticide residues in meat and eggs.

In addition to efforts that will help American farmers resolve some of the short-term issues they may face as FQPA is implemented, the Department will begin building the knowledge base needed to help U.S. agriculture transition to new pest management systems in the years ahead. Alternatives are available for some pesticides used in today's agricultural production systems, but farmers do not have alternatives to many pesticides they need to produce high quality agricultural products at prices consumers can afford. Research supported by the IPM Initiative will develop the knowledge and technologies needed to replace these pesticides. The IR-4 program has streamlined its decision-making process in order to more quickly bring alternative technologies into use where no or limited alternatives are presently available.

The Department is also working to more quickly get new information and technologies into the hands of the farmers who need it. Knowledge about new pest management technologies will be shared with farmers through CSREES-supported extension, education and training programs, including the IPM Education and Pesticide Applicator Training programs. These efforts are needed to help farmers to gain confidence in alternative strategies as they are demonstrated and evaluated in commercial production settings.

Budget Resources

The Department's IPM Initiative represents a comprehensive response to the pest management issues and challenges confronting the agricultural and urban sectors in the United States. Additional funding for the IPM Initiative was first proposed in the Department's FY 1996 budget. While some proposed increases have been provided, the full requests has

not been appropriated. The FY 1999 budget requests funding to support seven broad areas of activity, each of which contributes to the overall goals of the Initiative. Specifically, the Department's FY 1999 budget request will:

- ! **Help Agriculture Transition Post-FQPA.** The FY 1999 budget proposes to more than double funding for the PMAP, a competitive research grants program designed to develop new and effective pest management strategies for pesticides no longer available due to implementation of FQPA. It is likely that many broad spectrum pesticides currently used by farmers and other pesticide users will not be available to some farmers over the next five years. The additional funding will permit PMAP to mount a more intensive research effort to look for replacements for these critical pesticides.
- ! **Conduct Fundamental and Component Research.** Although some IPM methods are ready to implement, the knowledge base is not available to deal with many pest problems in an integrated fashion. ARS, CSREES and FS contribute to the development of this knowledge base by conducting fundamental and developmental research on specific aspects of pest management. The knowledge and technologies developed by these research efforts form the building blocks of comprehensive IPM systems, such as those implemented by the Department's areawide IPM programs. Biocontrol is one example of these basic building blocks, and the 1999 budget proposes additional funding to support biocontrol research by ARS. But the budget continues support for other types of fundamental and component research conducted by ARS and CSREES/land-grant university scientists, research ranging from pest biology to the study of spatial ecology. These investments will generate the knowledge needed to address the issues of tomorrow.
- ! **Implement IPM More Widely.** Once new knowledge is generated by PMAP or other research programs, it is essential that this knowledge be implemented. The FY 1999 budget requests new resources to support the implementation of IPM systems on an areawide or production region basis, by fostering public-private teams of growers, consultants, researchers, and important stakeholder groups. The budget request continues support for ARS' Areawide IPM Program so that promising new pest management technologies can be tested over large areas. The budget builds on this successful effort by proposing an increase of \$9.5 million to allow CSREES and the land-grant university system to implement approximately 20 areawide IPM system projects. These 20 projects would address many of the key production issues facing U.S. farmers today, including FQPA-driven concerns. The budget continues support for the Regional IPM Grants Program, which competitively awards funding for research and Extension projects to develop and demonstrate multi-tactic IPM systems so that they can be deployed through areawide programs. And continued support is provided to the IPM Education Program, which extends research results through a wide array of educational activities. All of these implementation efforts are based on the premise that success is dependant upon strong stakeholder partnership and collaboration, demonstration of the positive impacts and advantages of IPM systems over a large area, and the need to provide farmers, consultants and local organizations with an operational program.

- ! **Help USDA Apply What It Learns.** The Department is responsible for a wide array of pest management programs on the Nation's public lands and when exotic pests are introduced through trade or other means. The FY 1999 budget helps ensure that the Department introduces new IPM methods into the pest management programs it conducts. For example, APHIS uses IPM in programs to control fruit flies, boll weevils, and the silverleaf whitefly. Reductions in APHIS' Boll Weevil Eradication Program are based on plans to transfer full operational responsibility to growers in eradicated and non-infested areas, and to offer loans to finance a greater share of program costs in active eradication program areas. The FS uses IPM methods in its successful efforts to manage the spread of the gypsy moth throughout the Nation's forests and urban landscapes

- ! **Enhance Our Understanding of Pesticide Use and Impacts.** In FY 1998, Congress provided funding for additional sampling of children in the Continuing Survey of Food Intakes of Individuals. The 1999 budget recommends additional sampling of other population groups that may have special risk characteristics. Congress also returned funding of the Pesticide Data Program (PDP) to AMS in 1998. The 1999 recommendation includes additional funding for PDP to provide a quick response to FQPA-related needs. The budget calls for additional pesticide use surveys by NASS to be sure there is a good understanding of current practices for labor-intensive crops where worker exposure is a special concern.

- ! **Support Pesticide Registration.** Although research efforts supported by the IPM Initiative are focused on developing IPM systems that are less reliant on pesticides, there is a recognition that pesticides remain an important tool in many pest management systems. In FY 1998, Congress provided an increase in the Minor Use Program (IR-4) for minor crop registrations. The FY 1999 proposal requests additional funding for IR-4 to make sure that safe pesticides are not removed from the marketplace merely because registrants cannot afford to conduct tests required by EPA due to the relatively small size of the market. The National Agricultural Pesticide Impact Assessment Program (NAPIAP) is a coordinated, multi-agency program to gather data on current pesticide uses and management practices. NAPIAP assessments help decision-makers understand the implications of registration decisions for individual producers and for the agricultural sector.

- ! **Improve Coordination and Priority-Setting.** The OPMP was created to improve integration and coordination of pest management issues within USDA, and to strengthen communications with the existing network of grower organizations and crop specialists at land grant institutions. The FY 1999 budget supports the staffing and administration of OPMP with existing ARS NAPIAP Headquarters funding and requests an additional \$1.5 million to fund the development of ACommodity and Pest Management Profiles® for use in preparing transition strategies for at-risk commodities.

The following table summarizes the budget resources provided to the Department for the IPM Initiative and related programs. The budget summary is organized by program category, agency, and budget year. The budget summary corrects previous reports to include additional programs classified under the AIPM application® category, the largest of which is APHIS' Boll Weevil Eradication Program. The summary has also been modified to reflect actual, rather than estimated, spending for FY 1997.

Budget Summary

INTEGRATED PEST MANAGEMENT AND RELATED PROGRAMS

Program Level
(Dollars in Thousands)

Program	1996	1997 Actual	1998 Current Estimate	1999 Budget
IPM Initiative -- Research and Extension to address producer-identified needs				
CSREES:RE IPM Research Grant Prog.	\$2,731	\$2,731	\$2,731	\$8,000
CSREES:RE Pest Management Alternatives	1,623	1,623	1,623	4,200
CSREES:RE IPM Decision Support System	177	177	177	260
CSREES:Ext. IPM Implementation	10,783	10,783	10,783	15,000
ARS Areawide IPM Research	3,772	5,915	5,944	6,444
ERS IPM Research	500	500	500	500
Subtotal, IPM Initiative	19,586	21,729	21,758	34,404
Contributing Research				
CSREES:RE NRI, Formulas ² , Other ³	35,407	35,454	36,090	33,501
ARS Research	61,800	66,399	77,354	76,361
FS IPM Research	9,227	8,724	8,724	8,724
ERS Research	100	100	100	100
Subtotal, Continuing Research	106,534	110,677	122,268	118,686
IPM Application				
APHIS Application	53,002	57,988	56,551	44,668
NRCS/FSA IPM Application	6,616	6,617	10,000	10,000
FS-IPM Application	19,656	14,244	14,591	15,416
Subtotal, Application	79,274	78,849	81,142	70,084
Pesticide Use Data Collection and Analysis				
ARS Food Intake Surveys	0	1,000	5,000	1,500
NASS Pesticide Use Surveys	3,600	5,700	5,700	7,100
ERS Pesticide Use Analysis	1,600	1,600	1,700	1,700
AMS Pesticide Data Program	11,506	418	8,000	12,240
AMS Pesticide Record Keeping	1,511	2,439	2,547	2,576
Subtotal, Data Collection and Analysis	18,217	11,157	22,947	25,116

²Hatch; McIntire-Stennis; Evans-Allen; Animal Health.

³Sustainable Agriculture Research and Education; Special Research Grants; Rangeland.

Program	1996	1997 Actual	1998 Current Estimate	1999 Budget
Pesticide Registration, Clearance, Assessment, Training				
ARS-Minor Use Clearance (IR-4)	2,126	2,105	2,093	2,093
CSREES:RE Minor Crop Pest Mgt (IR-4)	6,186	6,186	9,465	11,143
ARS Pesticide Impact Assessment (OPMP)	1,184	1,193	1,192	2,692
CSREES-RE Pesticide Impact Assessment	1,327	1,327	1,327	1,327
CSREES-Ext. Pesticide Impact Assessment	3,313	3,214	3,214	3,313
ERS Pesticide Impact Assessment	300	300	300	300
FS Pesticide Impact Assessment	302	361	361	361
CSREES:Ext. Pesticide Applicator Training	0	0	0	1,500
Subtotal, Pesticide Registration	14,738	14,686	17,952	22,729
Total, IPM and Related Programs	238,349	\$237,098	\$266,067	\$271,019
Recapitulation by Agency				
AMS	13,017	2,857	10,547	14,816
APHIS	53,002	57,988	56,551	44,668
ARS	68,882	76,612	91,583	89,090
CSREES-RE	47,451	47,498	51,413	58,431
CSREES-Ext.	14,096	13,997	13,997	19,813
ERS	2,500	2,500	2,600	2,600
FS	29,185	23,329	23,676	24,501
NASS	3,600	5,700	5,700	7,100
NRCS	6,616	6,617	10,000	10,000
Total, IPM and Related Programs	\$238,349	\$237,098	\$266,067	\$271,019

Major Results and Accomplishments

I. The IPM Initiative

In FY 1997, USDA, the land-grant university system, and the private sector worked together to develop and implement IPM systems on numerous crops. Outstanding examples of this partnership include IPM programs for apple, corn, cotton, pear, potato, and rangeland weeds. These and many other successes are the result of interagency coordination and integrated team approaches to problem solving by Federal and State partners in addressing critical production issues identified by America's farmers, ranchers, foresters, nurserymen, and greenhouse producers.

Areawide IPM Research⁴. Projects continued to implement IPM systems to systematically reduce pest populations to predetermined levels through the use of uniformly applied pest mitigation tactics over large areas. Existing technologies were deployed over areas of sufficient size to optimize their effectiveness. The areawide approach provides a long-term solution to agricultural pest problems, resulting in fewer pest outbreaks. Projects were conducted through partnerships involving government, academia, and the private sector. Important results in FY 1997 include:

- ! The areawide IPM program for codling moth management was implemented on approximately 16,000 acres of apple and pear orchards in Washington, Oregon, and California. Participating growers successfully managed codling moth using mating disruption technologies, helping to overcome resistance to the organophosphate insecticide Guthion. The number of pesticide applications were reduced, resulting in a resurgence in natural enemy populations and almost complete control of secondary pests. Extension educators conducted education and technology transfer programs to help growers implement the areawide strategy.
- ! An areawide IPM program for corn rootworm was fully implemented in the Midwest. The program is based on an adult attracticide bait that could ultimately become the treatment of choice on the 20 million acres of U.S. cropland currently treated with corn rootworm insecticide.
- ! Two new areawide IPM programs were initiated. One was directed at insects in stored grain in Kansas and Oklahoma using early aeration to cool grain to reduce insect and mold population growth. Scientists from ARS, Kansas State University, and Oklahoma State University are working with farmers and grain elevator operators on this project. Another program is directed at leafy spurge (a non-native, invasive weed) in Montana, North Dakota, South Dakota, and Wyoming, using a natural insect predator. This is partnership effort involving ARS (Sidney, Montana), APHIS, North Dakota State University, Montana State University, and South Dakota State University, in cooperation with ranchers, Forest Service, CSREES, Bureau of Land Management, National Park Service, and the State Departments of Agriculture.
- ! A number of IPM methods were developed and adopted by growers to manage silverleaf whitefly on an areawide basis, including crop sequencing, water management strategies,

⁴ARS: \$5.9 million in FY 1997.

host-free periods, insect growth regulators and biological control agents. The introduction of these new management methods resulted in stable, and sometimes reduced, levels of whitefly populations and damage.

- ! The biological control was strongly supported by USDA, APHIS and ARS whose significant financial support permitted extensive foreign exploration around the world in search of exotic natural enemies. This material was shipped to the USDA, APHIS, Plant Protection and Quarantine Laboratory in Mission, Texas, to establish natural enemy cultures and clear each for field release using quarantine procedures and developing the appropriate environmental assessments for review. As a result of this activity, IPM approaches are presently being developed utilizing these exotic natural enemies in cucumbers, broccoli, cantaloupe melons, tomatoes, and cotton.
- ! A community-based field trial study for control of the deer tick which transmits lyme disease in the northeastern United States was implemented using small amounts of pesticide in a passive topical treatment system for deer.

IPM Systems Development and Implementation⁵. Research and extension programs were conducted to develop and help farmers implement IPM systems in every state. The Regional IPM Grants Program supported 50 projects in 24 States, addressing pest management problems in 15 crops, livestock and rangelands, and urban areas. Important results in FY 1997 include:

- ! The University of Wisconsin, USDA, and the Wisconsin Potato and Vegetable Growers Association continued development of IWISDOM®, a decision support system for potato and vegetable growers. Growers used this software on more than 70,000 acres of potato, saving Wisconsin growers an estimated \$10 million on production costs during the growing season.
- ! Researchers at the University of Idaho and Washington State University evaluated the impact of cover cropping on natural control of pests, crop nutrient status, and crop yield and quality in large on-farm studies in local vineyards. They concluded that the use of rye grass and hairy vetch as ground covers significantly reduces infestations of weeds and leafhoppers, and has a positive effect on vine nutrition in irrigated vineyards. This information was shared with grape growers in the Pacific Northwest as part of an effort to help them reduce their reliance on pesticides and lower operating costs using IPM methods.
- ! Researchers and Extension staff at the University of Georgia developed and helped landscape managers implement new IPM methods for lawns and landscapes. The project demonstrated that the use of IPM methods reduces pollution from pesticides and fertilizers in urban landscapes by up to 50 percent. A series of workshops and training programs were developed and presented to a wide audience. The knowledge and educational materials developed by this project provide a basis for implementing IPM methods on urban landscapes throughout the Southeastern United States.

⁵CSREES: \$3.4 million in FY 1997.

APHIS is working cooperatively with other Federal and State agencies, universities and industry to develop a biologically based IPM program for the Colorado potato beetle on potatoes in North Dakota. One grower alone has 40,000 acres of irrigated potatoes being grown in 13 States, mostly for the french fry industry, and is seeking alternative pest control practices.

IPM Education Program⁶. Agricultural producers and urban pest managers in every state were assisted in implementing IPM methods. An IPM coordinator was supported at each land-grant university to develop and help coordinate IPM research and extension programs. Agricultural producers, consultants, and pest managers were provided education and assistance through consultations, clinics, workshops, conferences, demonstrations, field days, seminars, and a wide variety of publications and video productions. Important results in FY 1997 include:

- ! The University of Missouri conducted education programs that helped cotton growers reduce annual insecticide applications from ten per season to three or four per season while also improving profitability.
- ! The University of Arizona developed and helped growers implement science-based IPM strategies on more than 100,000 cotton acres to manage over a dozen different pests.
- ! Montana State University helped wheat growers better manage the wheat stem sawfly, one of the most important insect pests of wheat in Montana, by developing a new IPM approach. The IPM approach increased net returns of participating growers by \$11 to \$30 per acre.

Pest Management Alternatives Program⁷. PMAP was established in FY 1996 to respond to the environmental and regulatory issues confronting agriculture by developing replacement technologies for pesticides under consideration for regulatory action by EPA and for which effective alternatives are not available. In FY 1997, a total of 24 projects were funded in 19 States and addressing pest management problems in 16 crops. Important results in FY 1997:

- ! The University of Minnesota, Montana State University, and North Dakota State University identified five new fungicides and a bacteria-based biocontrol alternative to triphenyltin hydroxide (TPTH), which is currently the only effective fungicide currently registered for control of *Cercospora* leafspot on sugar beet. The EPA has identified TPTH for label cancellation. *Cercospora* leafspot is an economically important disease that costs growers in Minnesota, Montana, and North Dakota (States accounting for more than 60 percent of U.S. sugar beet production) between \$130 and \$340 per acre in net profits.
- ! Researchers at land-grant universities in Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont demonstrated that a predatory mite (*Typhlodromus pyri*) can be successfully used for biological control of European red mite in apple orchards. Apple growers were able to increase their net profitability by \$50 per year by eliminating the need for the application of miticides.

⁶CSREES: \$9.1 million in FY 1997.

⁷CSREES: \$1.6 million in FY 1997.

Pest Management Information Decision Support System (PMIDSS)⁸. Development of the software product continued through the testing stage and deployment on the World Wide Web. At this time, users can access EPA registration and review data, IR-4 data, and information from the Current Research Information System (CRIS) to determine whether pesticide alternatives not under review are sufficient for management of a pest, or to identify knowledge gaps where alternative pesticides or management strategies need to be developed. Additional links were made to informational databases to provide decision-makers with ready access to pest management information. PMIDSS was initiated in 1994 to provide means to integrate and manage information from multiple data sources in order to identify and prioritize needs for research for alternative methods to manage key pests on important crops for which pesticides currently used are under regulatory review or where the pesticide is likely to be lost due to pest resistance. The system continues to be modified so that it can more fully address questions related to FQPA.

Research on Extent and Impacts of IPM Adoption⁹. New methods for incorporating the economic, environmental, and public health impacts of IPM programs into the evaluation of research and extension activities were developed. Probability-based surveys were designed and analyzed to assess the factors affecting farmers' decisions to adopt particular pest management strategies. The adoption of selected pest management practices associated with IPM systems in the United States was monitored, and several detailed case studies were developed to examine the impact of IPM on pesticide use, yields, and farm profits. Industry groups, nonprofit organizations, and others were assisted in designing their data-collection and evaluation procedures for alternative pest management systems.

II. Contributing Research

In FY 1997, four agencies (ARS, CSREES, ERS, and FS) supported a wide range of fundamental and component research that contribute to the development and implementation of IPM systems. The knowledge and technologies generated by this research provides the building blocks for IPM systems subsequently developed. These efforts contribute to our understanding of the taxonomy, biology, ecology, physiology, genetics, pathology, metabolism, and nutrition of pests and host plants and animals. This research included studies that resulted in the development of biologically-based pest control tactics, including the use of natural enemies and other biological control organisms, host resistance, naturally-derived attractants and repellents, and cultural and physical control practices. Although more than 80 percent of research was focused on the development of alternatives to conventional pesticides, some research focused on the development of safer and more effective ways to use pesticides. This research focused on application timing, formulations, modes of application, improved detection and measurement of pesticides and metabolites, and ways to eliminate or minimize residues.

ARS Research¹⁰. This research was focused on pests that have major national impact on agriculture, including: 1) Insects, such as the silverleaf whitefly, cotton bollworm/corn earworm, corn rootworm, Russian wheat aphid, fruit flies, codling moth, European corn borer, pink bollworm, boll weevil, gypsy moth, grasshoppers, root weevils, Colorado potato beetle, several stored

⁸CSREES: \$177,000 in FY 1997.

⁹ERS: \$500,000 in FY 1997.

¹⁰ARS: \$66.4 million in FY 1997.

product insects (Indian meal moth, rice weevil, maize weevil, sawtooth grain beetle, lesser grain borer), and several arthropods affecting man and animals (especially, fire ants, termites, screw worms, ticks and Africanized honey bees); 2) Plant pathogens, such as potato late blight, karnal bunt of wheat, wheat scab, citrus tristeza virus, sorghum ergot, golden nematode, and soybean cyst nematode; and 3) Non-native, invasive weeds, such as leafy spurge, water hyacinth, yellow starthistle, spotted and diffuse knapweeds, melalucca, and salt cedar. Important results from ARS research in FY 1997 include:

- ! A nematode biological control agent, *Steinernema riobris*, was developed for control of pink bollworm, corn earworm, and fall armyworm, among others. Based on this research, BioSys, Inc., started selling the nematode-based product commercially for use in IPM systems.
- ! ARS and Mycotech, Inc., agreed to jointly develop a fermentation method for mass producing a natural fungus discovered and developed by ARS to control the silverleaf whitefly, which causes losses to cotton and numerous other crops that exceed \$250 million annually. Decision-making IPM protocols for management of silverleaf whitefly have also been developed and adopted by cotton farmers, and a new early maturing cotton hybrid has been developed and released, which offers natural protection against this insect pest.
- ! Adult attracticide baits were developed for control of corn rootworm populations. It was demonstrated that the baits reduced corn rootworm populations by 85 to 95 percent using less than 10 percent of the pesticides used in current corn rootworm management programs. The baits are now being marketed by industry, and represent a key technology that is being deployed in the areawide IPM program for corn rootworm in the midwestern United States.
- ! A non-toxic natural product derived from kaolin clay was found to be effective in controlling insects and disease-causing microorganisms on field, horticultural, and ornamental crops.
- ! It was determined that releasing large numbers of the boll weevil parasite, *Catolaccus grandis*, on infested cotton can kill up to 95 percent of the weevils. This biocontrol agent has great potential as a component of an IPM system or eradication scheme for boll weevils.
- ! New crop varieties with pest resistance were developed, including a pear variety with resistance to fire blight disease and a sugarbeet variety with resistance to leafspot and crown rot.

CSREES Research¹¹. Research involving more than 480 scientists and 1,300 projects was conducted at every land-grant university in the United States. Research on a wide range of topic was conducted, including: 1) Crops, such as cotton, soybean, corn, and wheat; 2) Livestock, such as cattle, swine, poultry and sheep; 3) Rangelands; 4) Urban areas; 5) Weed management, such as invasive species; and 6) Pests, such as insects, nematodes, mites, and plant pathogens. Research was conducted to enhance our understanding of pest and beneficial life cycles, population dynamics, the biochemical nature of resistance, the mode of action of pesticides, epidemiology, ecology, and the development of pest-resistant crop varieties and livestock breeds.

¹¹CSREES: \$35.4 million in FY 1996.

Forest Research¹². Priority areas of research were detection and management strategies for introduced exotic forest pests, including noxious weeds; alternatives for methyl bromide fumigation in forest nurseries; continued development of behavioral chemicals in management of insect pests; and expanding research on the role of microorganisms and arthropods in maintaining the health and productivity of forest ecosystems. Research projects emphasized the study of the basic ecology of organisms and their hosts, evaluation of effects and impacts of pests, and the development of IPM systems. Important results from FS research in FY 1997 include:

- ! An improved formulation of a biological control agent, Bt, was developed for management of the introduced European gypsy moth. This agent and the virus GYPCHEK was determined to be effective against the exotic Asian gypsy moth.
- ! New methods were developed for an insect pathogen that controls the introduced European gypsy moth in the forest.
- ! A biological control agent for soil pathogens to test as an alternative to methyl bromide fumigant (an ozone depleter) in forest nurseries.
- ! A new tool was developed to assist forest managers in evaluating the extent of ozone injury on pines in the western United States.
- ! Management strategies were developed for the introduced Asian long-horned beetle (detected in Brooklyn, New York) and the pine shoot beetle (detected in the Midwest).
- ! Improved methods were developed to deploy a natural behavioral chemical that disrupts attacks by the southern pine beetle on high value pines colonized by the threatened and endangered red-cockaded woodpecker.

III. IPM Application

In FY 1997, three agencies (APHIS, FS, NRCS) applied IPM methods on a day-to-day basis. These programs helped farmers implement IPM methods and helped to protect federally owned forest land in the United States.

Environmental Quality Incentives Program¹³. Using the Conservation Practice Standard 595, APest Management, cost-share and incentive payments were provided to farmers by NRCS for implementation of IPM methods that result in the reduction in environmental risks associated with pesticide use. These payments were made on a per acre basis and are set by EQIP State technical committees. Typically, payments ranged from \$5 to \$15 per acre, based on the cost of scouting the particular crop grown. Approximately 1 million acres of IPM cropland was covered by incentive payments for a period of up to three years, with the possibility of time extensions as new IPM methods are introduced. Priority areas for EQIP were designated by State Conservationists based on the advice of the State technical committees.

¹²FS: \$8.7 million in FY 1997,

¹³NRCS: \$6.6 million in FY 1997.

FS Application¹⁴. A priority area was the Forest Health Monitoring Program, which enables the early detection and evaluation of changes in health conditions across time, by establishing standardized baseline information and providing data on long term trends in forest health. Sixty percent of the forested area of the lower 48 States was monitored with an intensive permanent grid system and 600 million acres were extensively surveyed from the ground and air to detect insects and diseases across all forest land ownerships. Prevention and suppression activities were part of an IPM approach to managing major forest pests. These activities included surveys to delineate treatment areas, surveys to assess treatment effectiveness and the conduct of environmental analyses to comply with the National Environmental Policy Act. Prevention and suppression efforts focused on current major pest and disease outbreaks such as the gypsy moth, southern pine beetle, western bark beetles and dwarf mistletoes. Suppression treatments to insect and disease outbreaks were applied on 578,000 acres of National Forest System lands, 629,000 acres of other federal lands, and 294,000 acres of cooperative lands. FS also assisted APHIS in the eradication of the Asian long horned beetle in New York. Spread of this insect could have resulted in significant economic, social and ecological impacts on urban, rural, and forest areas in North America.

Thirty-two projects were supported by funding intended to improve the efficiency of forest pest management through the development of new technologies and strategies. These projects included work in pest risk modeling, aerial survey and visualization technology, environmental impacts and alternative methods to pesticide use.

IV. Pesticide Use Data Collection and Analysis

Food Intake Surveys¹⁵. The Continuing Survey of Food Intakes by Individuals (CSFII) was started, and will provide EPA with commodity-level food intake data for use in tolerance reassessment. When completed, CSFII and a companion survey called the ASupplemental Children's Survey® will provide food intake data for approximately 5,700 children 18 months old and less, and 5,000 children 9 years old and less. These data will provide fundamental information for a comprehensive risk assessment of potential affects of pesticide residues on infants and children.

Pesticide Use Surveys¹⁶. Statistically reliable State-level information was collected on pesticides used during the production of food crops. Information is collected on the use of pest scouting, pest-resistant crops, rotations, habitat management, and other nonchemical practices and inputs that are used in IPM systems. Information on the use of pest infestation thresholds, computerized decision models, herbicide banding, and other techniques to improve the efficiency of pesticide use in some IPM systems were also collected. The surveys collect data on over 50 fruit, vegetable and field crops, and represent 60 percent of U.S. crop production. Pest management practice data is supplemented with economic surveys for several specialty and field crops. The following surveys were conducted:

! Agricultural Resource Management Study.

¹⁴FS: \$14.2 million in FY 1997.

¹⁵ARS: \$1 million in FY 1997.

¹⁶NASS: \$5.7 million in FY 1997.

- ! The Fruit and Vegetable Chemical Use Surveys. Conducted in alternate years (fruit odd years, vegetables even years). States and commodities are selected for the program based on the funding level, the desire to include States comprising 80 to 85 percent of U.S. fruit and vegetable acreage, and data needs from other agencies. NASS included 13 States in the 1996 Vegetable Chemical Use Survey and 11 States in the 1997 Fruit Chemical Use Survey. Approximately 30 crops were covered in each survey. The chemical use surveys are conducted during the fall of each year and data are published the following July. Data published include all pesticides used by State, by crop, and by active ingredient. Items published are percent of acres treated, number of applications, rate per application, rate per crop year and total amount of each active ingredient applied for the year.
- ! Fall Area Survey. Starting in FY 1997, NASS received \$1.5 million to conduct a national survey of farmers on an annual basis. The FY 1997 survey collected information on IPM practices used and pesticides used on a whole farm basis, including pesticide use on livestock, buildings, pasture, and general farm use. The Fall Area Survey is designed to complement the fruit and vegetable crop specific survey. The results from Fall 1997 survey will be published in 1998.

Pesticide Data Program¹⁷. PDP was initiated in FY 1991 to collect and analyze pesticide usage and residue data as they affect concentration levels of food, with a focus on fruits and vegetables. The program is designed to enhance the risk assessment process and provide information for government agencies such as EPA and the Food and Drug Administration to respond effectively to environment and food safety issues.

Pesticide Impact Assessment¹⁸. Information on pesticide use and pest control practices was developed and analyses of the economic impacts of FQPA on American agriculture were completed. Analyses assessed the impacts of pesticide regulations on agricultural productivity, supply and product prices, and pest management issues related to health and the environment.

Minor Use Program¹⁹. The Minor Use Program (IR-4) conducts research to develop data on residues, effectiveness and crop safety for pest control products important to producers of minor food crops and ornamentals. IR-4 updated its strategic plan for minor crop pest management in order to assure alternatives are available to replace pesticides "at risk" as a result of provisions of the FQPA. This strategic plan establishes research and registration goals for reduced risk pesticides, pest control products that must be registered with EPA that are needed for IPM programs, and biologically based pest management alternatives. As called for in the plan, 45 reduced risk pesticide studies and 8 biopesticide studies were conducted to replace "at risk" pesticides with safer pest control products for minor crop uses began. About 40 percent of these pesticides will contribute to existing or proposed IPM programs. The completion of this research will lead to the submission to EPA of 238 registrations for safer pest control products on 96 minor crops over the next 2 years.

¹⁷AMS: \$418,000 in FY 1996. Supported with funds appropriated to appropriated to EPA in FY 1997. (Total appropriation was \$11.6 million in FY 1996.)

¹⁸Four agencies (ARS, CSREES, ERS, and FS) comprise NAPIAP: Total budget was \$6.3 million in FY 1997.

¹⁹Two agencies (ARS and CSREES) comprise IR-4: Total budget was \$8.3 million in FY 1997.

References

Rajotte, E. G., G. W. Norton, R. F. Kazmierczak, M. T. Lambur, and W. A. Allen. 1987. The National Evaluation of Extension's Integrated Pest Management (IPM) Programs. Virginia Polytechnic and State University, Blacksburg, Virginia.

Benbrook, C. M. 1996. Pest Management at the Crossroads. Consumers Union. Yonkers, New York.

Norton, G. W. and J. Mullen. 1994. Economic Evaluation of Integrated Pest Management Programs. Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Sorensen, A. A. 1993. Regional Producer Workshops: Constraints to the Adoption of Integrated Pest Management. National Foundation for IPM Education, Austin, Texas.

Sorensen, A. A. 1994. Proceedings of the National Integrated Pest Management Forum; June 17-19, 1992, Arlington, Virginia. American Farmland Trust, Center for Agriculture and the Environment, DeKalb, Illinois.

U.S. Congress. 1993. Testimony of Carol M. Browner, Administrator EPA; Richard Rominger, Deputy Secretary of Agriculture; and David A. Kessler, Commissioner of FDA. Hearing before the Committee on Labor and Human Resources, U.S. Senate, and Subcommittee on Health and the Environment, Committee on Energy and Commerce, U.S. House of Representatives; September 21, 1993. Washington, D.C.

USDA. 1994a. Adoption of Integrated Pest Management in U.S. Agriculture. Economic Research Service, Agriculture Information Bulletin No. 707. Washington, D.C.

USDA. 1994b. Strategic Plan for Implementation of the USDA Integrated Pest Management Initiative. USDA IPM Task Force. Washington, D.C.

USDA. 1994c. USDA's Integrated Pest Management (IPM) Initiative. Office of Communications, News Backgrounder, Release No. 0942.94. Washington, D.C.

USDA. 1997. Strategic Plan 1997-2002: A Health and Productive Nation in Harmony With the Land. Office of the Secretary, Washington, D.C.